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The Puget Sound Ecosystem Portfolio Model: Evaluating Alternative Puget Sound Futures

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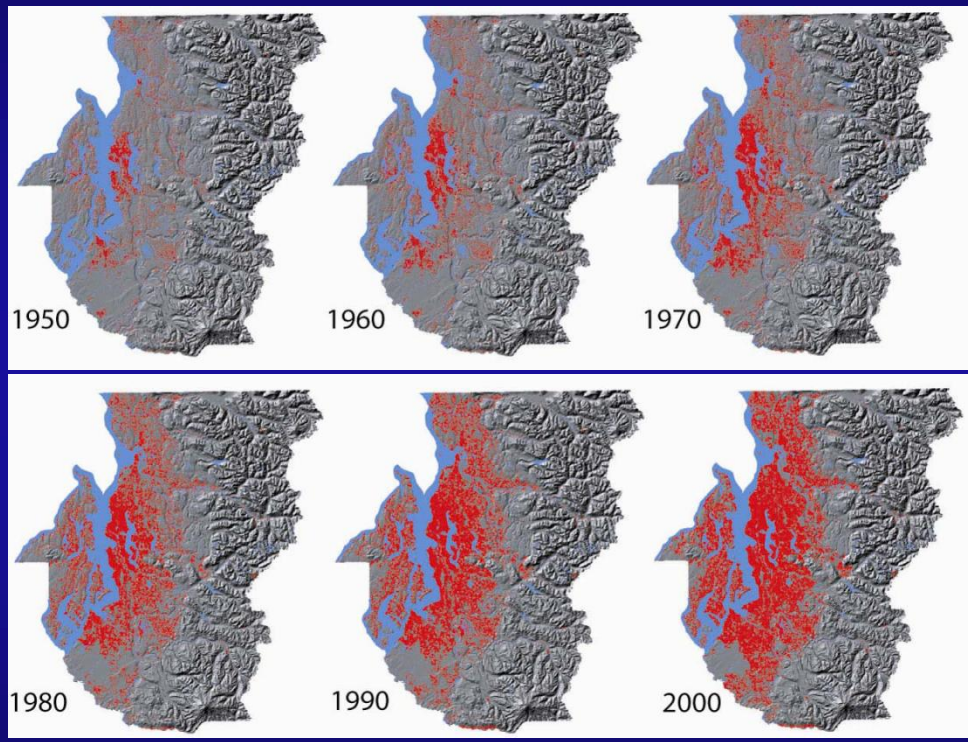
Background

The Puget Sound Ecosystem Portfolio Model:
A Regional Analysis for Supporting Ecological Restoration Planning

- **PS EPM to be used by PSNERP "Without Project" analysis and Puget Sound Partnership for restoration planning**

- **Developing set of spatially explicit metrics for relating land use/nearshore changes to human well-being, ecosystem services for 2060 development scenarios**

Historical development
1950 – 2000



Maps by University of Washington
Urban Ecology Research Lab

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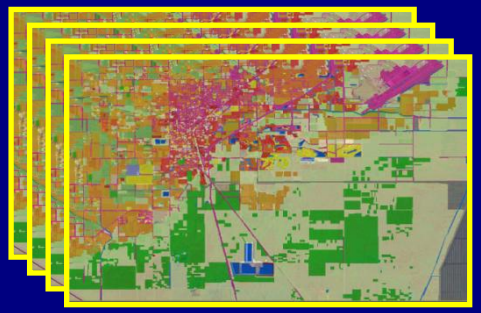
Linked scenario-development and scenario-evalution projects

- Scenario development (Bolte et al., OSU)
  - Spatially-explicit simulations of basin-wide land-use conversions and nearshore modifications through 2060
- Scenario evaluation (PS EPM, this work)
  - Spatially-explicit landscape and nearshore models relating these scenarios to biophysical changes in the nearshore relevant to human well-being
- Both projects make significant use of geodatabase developed by PSNERP for their historical land-use/nearshore “change analysis”

Puget Sound EPM

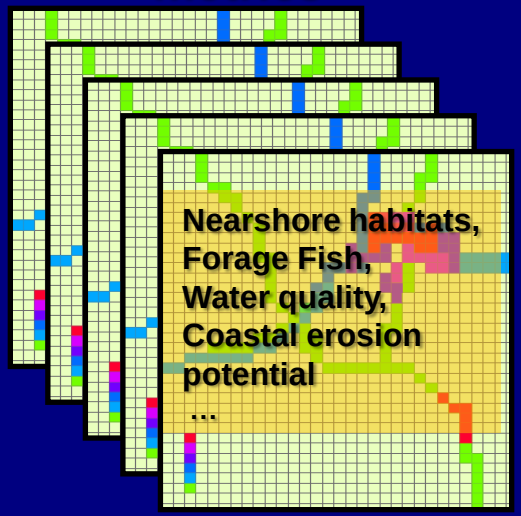
1. Multiple development scenarios considered



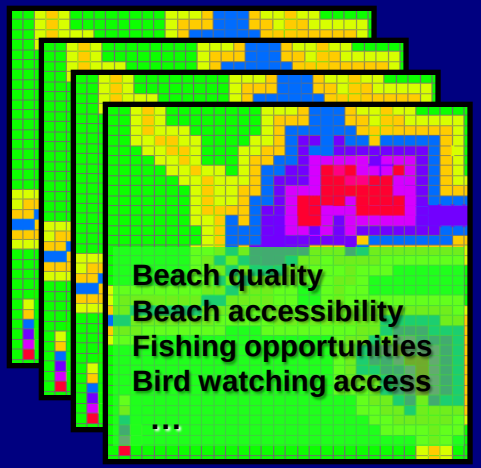
Model-based characterizations of outcomes

2. Scenarios evaluated against multiple metrics

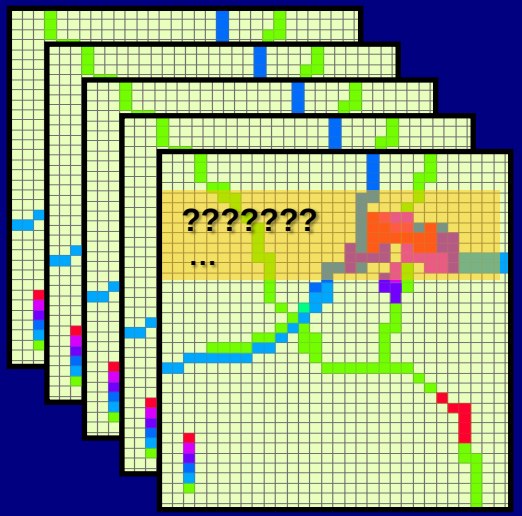
Nearshore condition metrics



Recreation metrics



Water, Economy, …….??



EPM:
Human Well-Being
and Ecosystem Services Metrics

Choosing metrics

- Puget Sound Partnership indicators development
- Puget Sound/Georgia Basin Human Dimensions Forum
- Workshop held at the University of Washington last April
  - Participants: PSNERP, PSP, NST, consultants
  - Whose values?
- Metric modeling workshops and meetings
  - Eelgrass habitat suitability workshop in April
  - Forage fish spawning workshop in August
  - Beach erosion index workshop in October
- Very ambitious project goals, limited resources
  - The best we can do this year
  - Additional HWB criteria/metrics/measures in future work

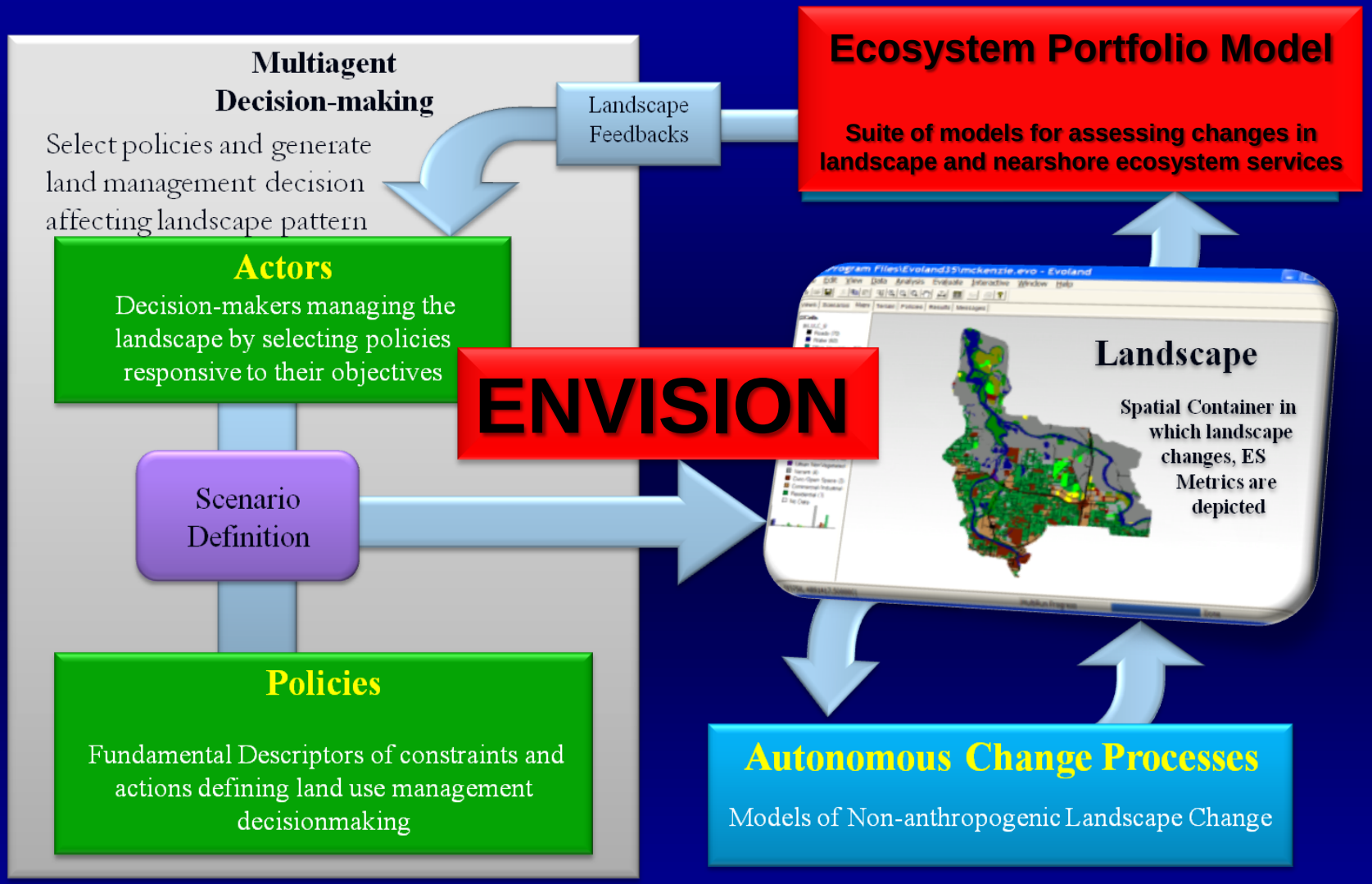
EPM Criteria	Related to VEC or Ecosystem Service	Model
Eelgrass habitat suitability	Biodiversity; habitat, provisioning of food	Controlling Factors Model (PNNL, R. Thom)
Forage fish spawning potential	Relevant to provisioning of food, food web support, iconic species	WDFW data and modeling collaboration between WDFW and USGS
Shellfish pathogen loadings	Provisioning of food; recreation	Statistical model based on land cover data and data from WA Dept of Health
Beach erosion index	Erosion control; beach habitat (eelgrass, forage fish); recreation	Index; PSNERP data
Nearshore recreational visits	Recreation; tourism	Statistical model based on data from WA State Parks
Nutrient loadings to nearshore	Beach condition (eutrophication, dissolved oxygen, recreation)	USGS SPARROW model for nutrients (Wise et al.)

Development Scenarios

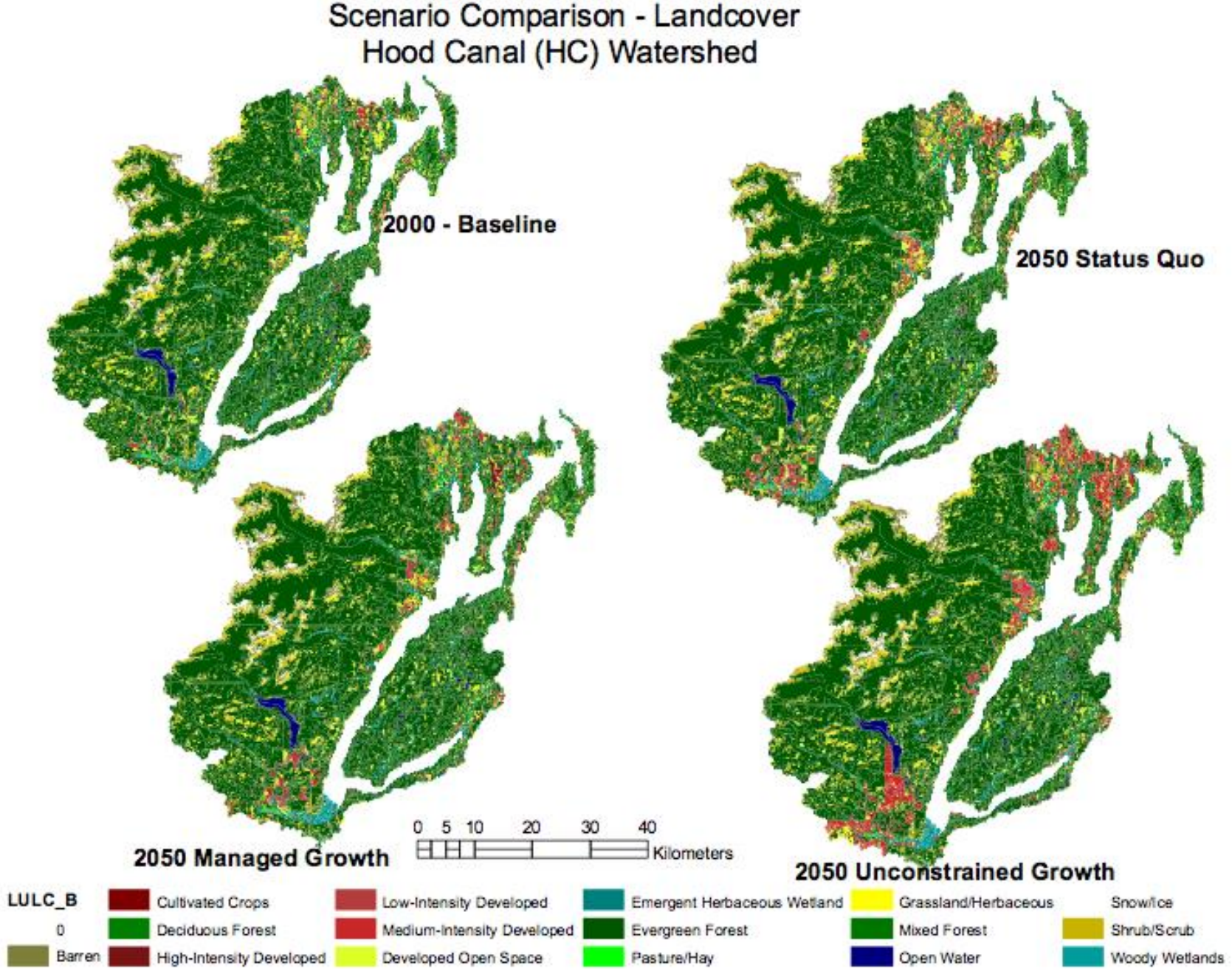
Three scenarios

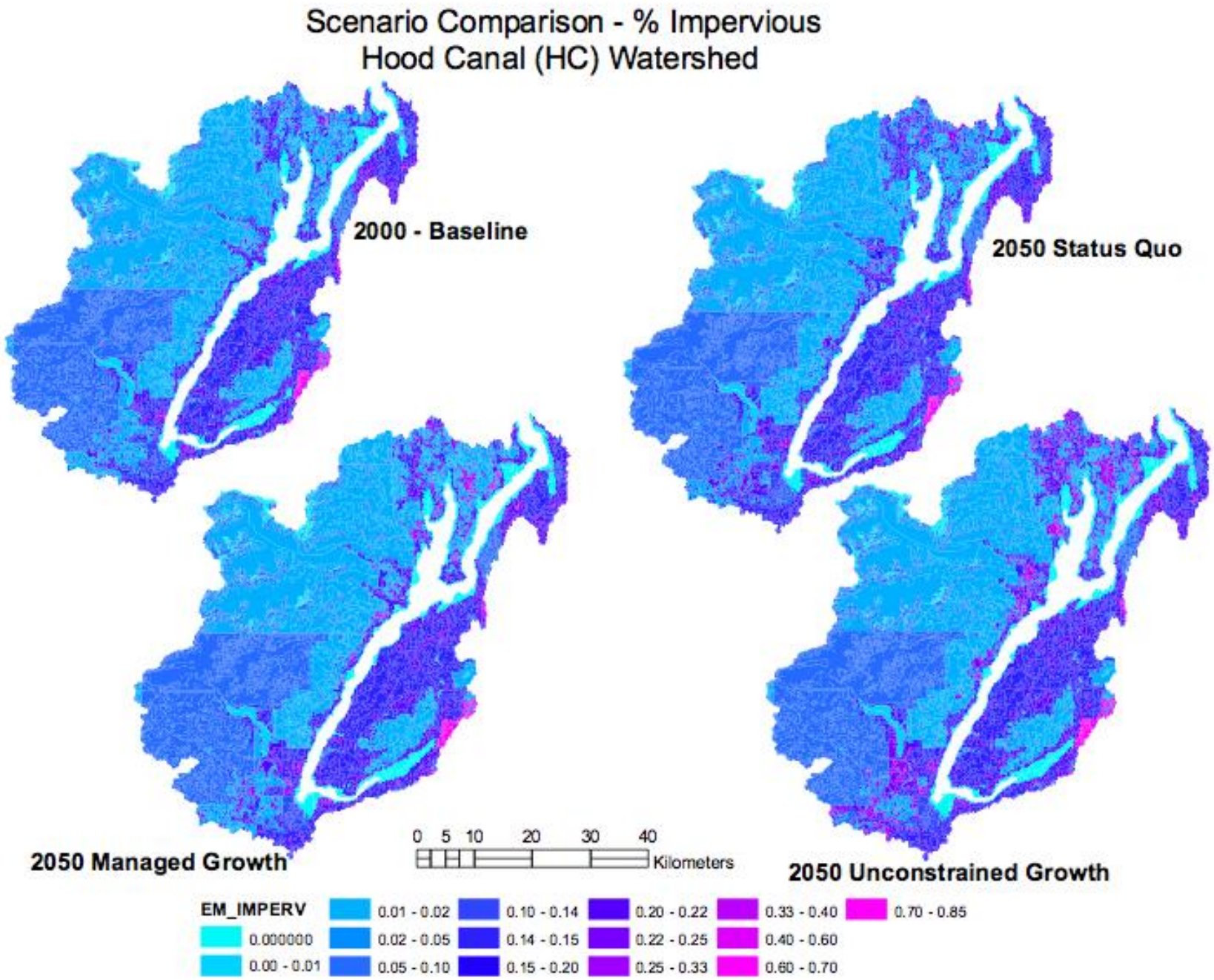
- **Plan Trend** – use Puget Sound Action Agenda, Puget Sound Regional Council Vision 2040, current trends, existing plan elements for growth, nearshore modifications, moderate restoration/conservation emphasis
- **Ecosystem Services Emphasis** – compact growth pattern, reduced placement, impact of nearshore modifications, aggressive restoration/conservation policies.
- **Development Emphasis** – less restrictive development pattern and nearshore modification policies, limited conservation orientation

Integrated ENVISION/EPM Modeling Framework



ENVISION: John Bolte et al. – Oregon State University
EPM: B. Labiosa, K. Byrd, J. Kreitler. – U.S. Geological Survey


Scenario Comparison - Landcover
Hood Canal (HC) Watershed
2000 - Baseline
2050 Status Quo
2050 Managed Growth
2050 Unconstrained Growth
0 5 10 20 30 40
Kilometers
LULC_B
0
Barren
Cultivated Crops
Deciduous Forest
High-Intensity Developed
Low-Intensity Developed
Medium-Intensity Developed
Developed Open Space
Emergent Herbaceous Wetland
Evergreen Forest
Pasture/Hay
Grassland/Herbaceous
Mixed Forest
Open Water
Snow/Ice
Shrub/Scrub
Woody Wetlands


Scenario Comparison - % Impervious
Hood Canal (HC) Watershed
2000 - Baseline
2050 Status Quo
2050 Managed Growth
2050 Unconstrained Growth
0 5 10 20 30 40
Kilometers
EM_IMPERV
0.000000
0.00 - 0.01
0.01 - 0.02
0.02 - 0.05
0.05 - 0.10
0.10 - 0.14
0.14 - 0.15
0.15 - 0.20
0.20 - 0.22
0.22 - 0.25
0.25 - 0.33
0.33 - 0.40
0.40 - 0.60
0.60 - 0.70
0.70 - 0.85

Puget Sound Ecosystem Portfolio Model Example: Comparing scenarios with the beach erosion index

Beach erosion index

Measures:

For a given bluff-backed, barrier, or pocket beach, relative potential of the beach to erode because of loss of sediment supply due to armoring placement

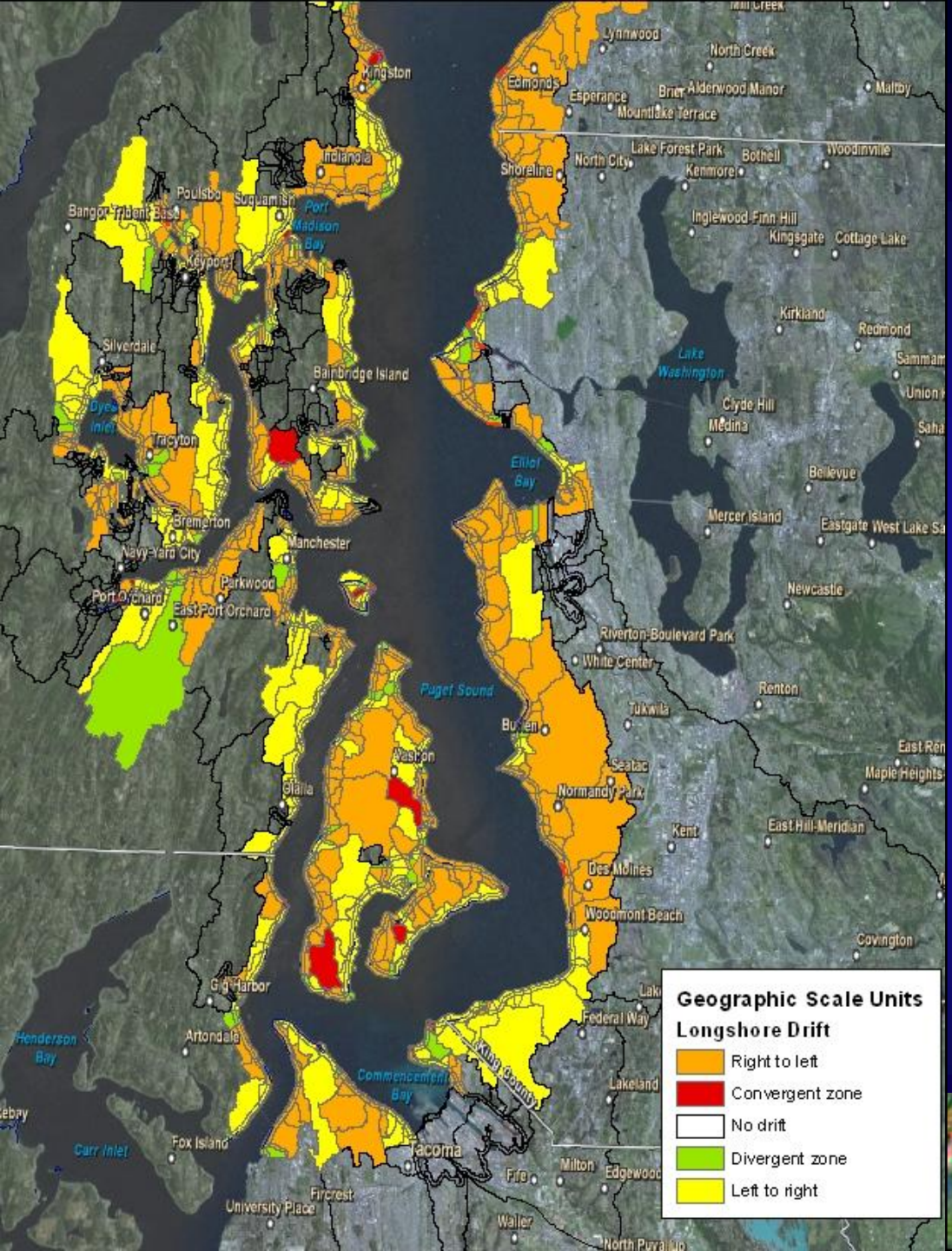
Considers:

- Fetch distance
- Percent of beach length that is armored
- Armor length in bluff-backed beaches in divergent zone

- **Scores:**
  - Low (0 - 1): little loss of sed supply, short fetch
  - Medium (2 - 3): some loss of sed supply …
  - High (4 - 5): appreciable loss of sed supply, long fetch
- **For more details, see poster 15-D**

PSNERP Historical Change Analysis Geodatabase:

Shoreline Accounting Units
with attributes for longshore drift



Beach erosion index scenario comparisons: Bainbridge Island

Score

0 - 1

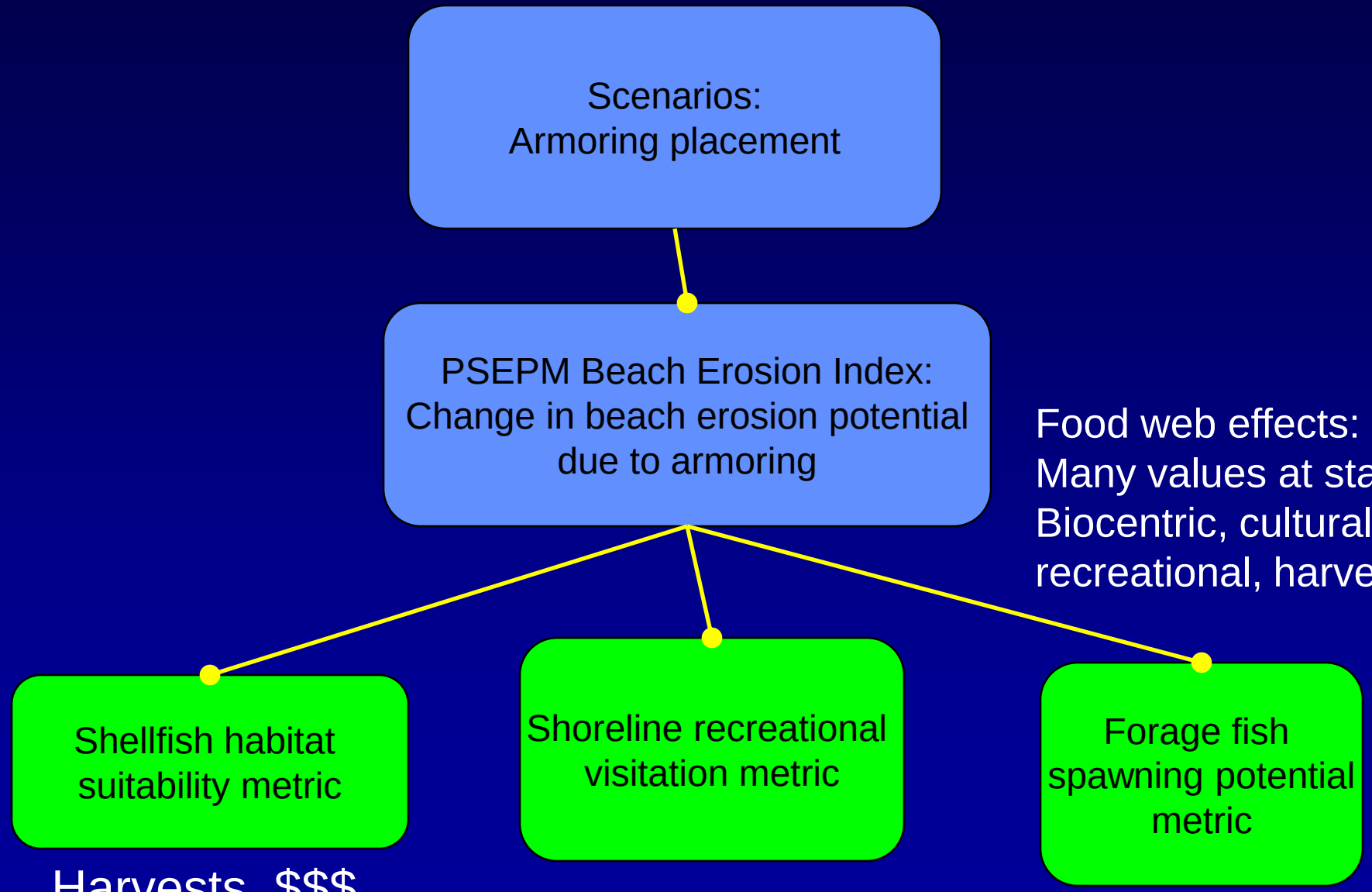
2 - 3

4 - 5

Managed Growth, 2060

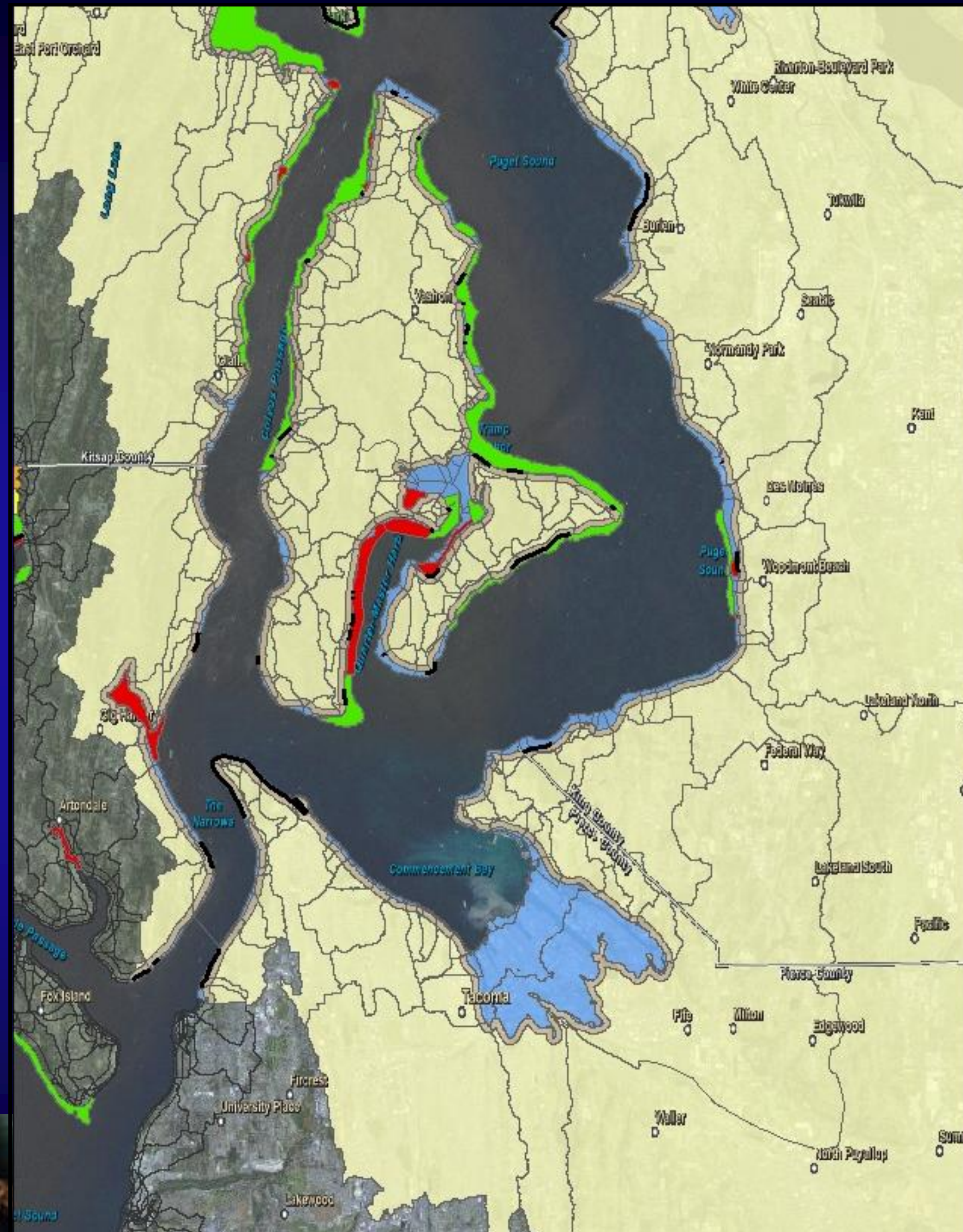
Unconstrained Growth, 2060

Taking it further: Scenarios, families of related metrics, values



Shellfish growing area closures:

Land-use → Pathogen loadings



recreational shellfish beaches

growingareas

CLASS

- Approved
- Conditional
- Prohibited
- Restricted

fd_GSUs

Shorezone

- beyond 200 m from shoreline
- shoreline to 200 m landward
- shoreline to 10 m water depth

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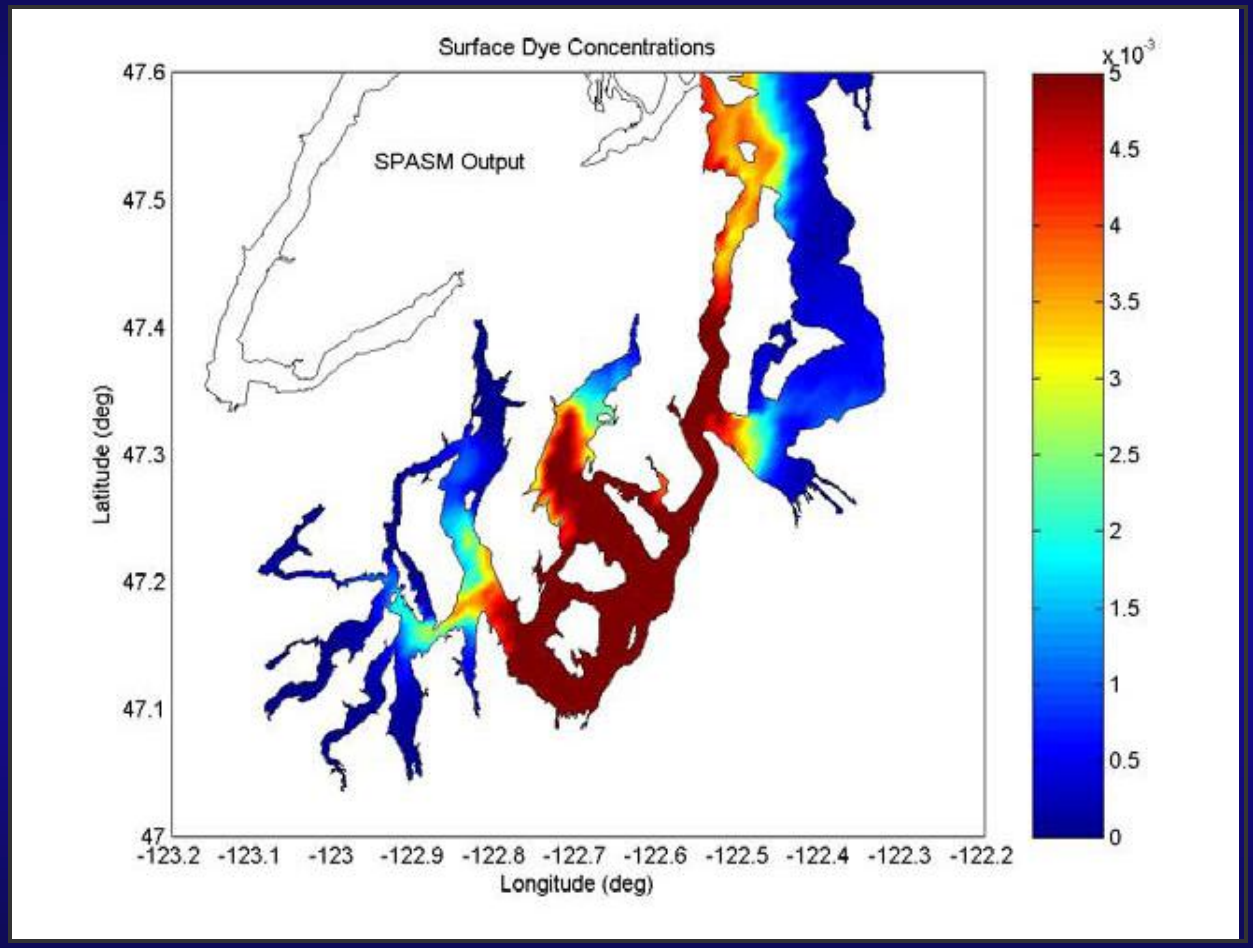
Shellfish closures: retention times at beaches



Department of Ecology
Hammersley Oakland Bay Oceanographic (HOBO) circulation model to study discharge scenarios

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Thank you!

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Beach erosion index

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Pathogens loading

Mindy Roberts (WA Dept of Ecology)

Nutrient loading

Dan Wise (USGS)